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SWITCH DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to switch devices that are operated with a tilting movement by using, for example, an operating knob. In particular, the present invention relates to a switch device that tilts a conductive plate to move into and out of contact with stationary contacts to switch between ON and OFF modes. Such switch device are used as a driving switch for an automatic window unit in a vehicle.

2. Description of the Related Art

Fig. 9 is a sectional view of a conventional switch device. As is shown in Fig. 9, a case 1 includes a bottom wall 1a on which a first stationary contact 2a, a second stationary contact 2b, and a third stationary contact 2c are fixed by insert molding; and three terminals 8 which extend from the stationary contacts 2a, 2b, and 2c and protrude downward from the case 1. The stationary contacts 2a, 2b, and 2c are exposed on the bottom wall 1a, the stationary contact 2a being disposed in the center to function as a fulcrum for tilting a conductive plate 3. The conductive plate 3 is a metal plate with an M-shape from a side view, having a depressed portion 3a between two elevated portions 3b and 3c. One longitudinal end of the conductive plate 3 can move into and out of contact with the stationary contact 2b, while the other end has the same movement with the stationary contact 2c. An actuating portion 4a of a driver 4

is disposed on the conductive plate 3. A coil spring 5 causes the driver 4 to constantly apply force towards the bottom wall 1a, whereby the actuating portion 4a is in resilient contact with the conductive plate 3. The driver 4 and the coil spring 5 are mounted inside a housing 6a of a tilt lever 6. The tilt lever 6 is tiltably supported by a cover 7 which covers the case 1. An operating knob, which is not shown in Fig. 9, is attached to the tilt lever 6 by an appropriate method. An operator of the apparatus tilts the operating knob to move the tilt lever 6, thereby sliding the actuating portion 4a on the conductive plate 3.

Fig. 9 shows a neutral state (stand-by mode) where the tilt lever 6 is not being moved. In Fig. 9, the stationary contacts 2a and 2c are connected via the conductive plate 3, and the stationary contacts 2a and 2b are kept in an OFF mode. When the operating knob is pressed to tilt the tilt lever 6 clockwise with respect to the drawing, the actuating portion 4a slides on the elevated portion 3b of the conductive plate 3 as the coil spring 5 becomes compressed. As the actuating portion 4a passes over the stationary contact 2a, the conductive plate 3 tilts counter-clockwise. As a result, the conductive plate 3 moves out of contact with the stationary contact 2c and moves into contact with the stationary contact 2b to create a state such that the stationary contacts 2a and 2b are connected via the conductive plate 3 to be switched to an ON mode. When the force applied from the operating knob is removed, the restoring force of the coil spring 5 causes the actuating portion 4a on the elevated portion 3b to slide

in the opposite direction. This causes the actuating portion 4a to reversely pass over the stationary contact 2a to tilt the conductive plate 3 clockwise, whereby the switch device is switched back to the stand-by mode shown in Fig. 9. Consequently, the stationary contacts 2a and 2b are automatically switched back to an OFF mode.

If the tilt lever 6 is tilted counterclockwise in a stand-by mode shown in Fig. 9, the actuating portion 4a slides along the elevated portion 3c. However, since the conductive plate 3 is already pressed against the stationary contact 2c and therefore cannot be tilted, the stationary contacts 2a and 2b are kept disconnected to be in an OFF mode.

The switch devices of this type are extensively used as a driving switch for automatic window units in vehicles. In such a unit, a driving signal for opening and closing the window is output for the period of time that an operating knob is pressed, by which the window can be manually operated until the desired opening is obtained.

The above-mentioned conventional switch device has the driver 4 combined with the coil spring 5 on the conductive plate 3 and therefore requires a large housing 6a in the tilt lever 6. For this reason, the tilt lever 6 requires a reasonable height and may interfere with the achievement of a lower profile of the apparatus. Furthermore, the tilting movement requires a clearance space C between the tilt lever 6 and the cover 7. Through this space, foreign particles, such as dust, may enter and land on the contacts in the case 1, which may lead to a loss of reliability in the connections.

In a driving switch of an automatic window unit in a vehicle, two groups of the stationary contacts 2a, 2b, and 2c are disposed on the bottom wall 1a of the case 1 in a pair of rows, each group being provided with components such as the conductive plate 3 and the actuating portion 4a to form first and second switch elements. When the operating knob is pressed in one direction, the first switch element outputs a driving signal for opening, whereas pressing the knob in the other direction turns on the second switch element to output a driving signal for closing. To achieve such a double-pole double-throw switch device with the structure of the conventional apparatus as is shown in Fig. 9, the tilt lever 6 must be assembled with the case 1 and the cover 7 very carefully without misaligning the driver 4 and the coil spring 5. Such assembly process is extremely inefficient.

Also, in a driving switch of an automatic window unit in a vehicle, a function which enables the window to be fully opened or fully closed through one-touch operation is in demand, although adding this type of function to the conventional switch device would normally require a push switch in the vicinity of the case 1. In such a unit, when the tilt lever 6 is tilted with an operating knob, a single-purpose driving element presses the push switch to output a driving signal for a full-opening or a full-closing operation. However, if the driving element for the push switch is disposed outside the case 1 in a preferable position where the element can operate with respect to the timing of the movement of the driver 4, the whole apparatus may lead to a

large-scale and a complex structure.

SUMMARY OF THE INVENTION

An object of the present invention is to solve the problems of the conventional switch devices and to provide a highly reliable switch device having a lower profile and more simple structure and being capable of ready assembly.

The switch device of the present invention includes a case with a bottom wall and a top opening; two switch elements assembled in the case; a common leaf spring whose restoring force is applied to the two switch elements; and a cover that presses a leaf spring and that covers the top opening. Each of the switch element includes stationary contacts that are fixed to the bottom wall of the case; a conductive plate that is disposed on the bottom wall and is tiltable to move into and out of contact with the stationary contacts; and a driver disposed on the conductive plate, the driver being rotatable around a shaft thereof and movable vertically. The driver includes a protruding receiver which protrudes from the case; and a sliding portion that slides on a slope of the conductive plate when the protruding receiver is pressed downward. The leaf spring includes a compressed portion which is resiliently compressed by the cover; and a pair of pressing strips which connect with the compressed portion and resiliently urge the shaft of the driver towards the bottom wall of the case.

With the pressing strip resiliently urging the shaft of the driver, the force applied by an operating knob to the

protruding receiver moves the driver and causes the sliding portion to slide on the slope of the conductive plate. This allows the conductive plate to tilt and therefore excludes the need for an external driving element for tilting the conductive plate to move into and out of contact with the stationary contacts. Furthermore, the leaf spring can be disposed in the narrow space provided on the shafts of the drivers, whereby an apparatus with a lower profile can be readily achieved. The protruding receiver, which protrudes from the case, can turn on the push switch in the vicinity of the case when the operating knob is pressed with a great force to achieve a multifunctional apparatus. The additional driving element for the push switch therefore is not necessary, leading to a low-profile apparatus with a more simple, compact structure. After the conductive plates and the drivers included in the two switch elements are disposed onto the bottom wall, the leaf spring and the cover are disposed onto the switch elements, whereby the one common leaf spring applies a restoring force to both of the switch elements. This enables an automatic assembly of the apparatus. Furthermore, because the top opening of the case is covered with the cover, the case is protected from foreign dust particles, maintaining reliability in the connections for a longer period of time.

In this structure, the compressed portion of the leaf spring includes first bent strips formed of sharply bent first longitudinal end segments extending from the pressing strips, the first longitudinal end segments being bridged;

and a second bent strip formed of sharply bent second longitudinal end segments extending from the pressing strips, the second longitudinal end segments being bridged. The cover is mounted above the leaf spring disposed at the top of the case and resiliently urges the first and the second bent strips. Thus, a resilient force is applied towards the pressing strips to create a spring force therein. The leaf spring, which applies its restoring force to the switch elements, has a simple, low-profile structure and contributes to lower costs of the parts as well as a lower profile apparatus.

The structure includes sidewalls orthogonal to the bottom wall for determining the longitudinal position of the pressing strips, and guides in the shafts of the drivers for determining the lateral position. Thus, the positioning of the leaf spring at the top of the case can be performed during the assembly, as well as preventing the misalignments of the components. Accordingly, the automatic assembly becomes easier and greatly reduces the assembly costs.

In plan view, this structure may preferably have the two switch elements including the stationary contacts, the conductive plate, and the driver being disposed point-symmetrically so that the apparatus may have a smaller size.

The present invention discloses a switch device which is driven when an operating knob is directly pressed against drivers, the drivers then being generated a tilting movement to tilt conductive plates so that the apparatus can be turned on. Since a leaf spring is disposed in narrow spaces

provided on shafts of the drivers, an apparatus with a low profile can be readily achieved. Furthermore, in the assembly of this switch device, the conductive plates and the drivers composing the two switch elements are mounted on a bottom wall of a case, and the leaf spring and a cover are then mounted on the switch elements, whereby both of the switch elements receive the restoring force of one common leaf spring. Thus, a highly efficient, automatic assembly of the apparatus can be achieved. Furthermore, because a top opening of the case is covered with the cover, the case is protected from foreign dust particles to maintain reliability in the connections for a longer period of time.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of a switch device according to an embodiment of the present invention.

Fig. 2 is a perspective view of the switch device when an operating knob is not mounted thereon.

Fig. 3 is a sectional view of the switch device shown in Fig. 2.

Fig. 4 is a diagram illustrating the operation of the switch device.

Fig. 5 is a plan view of a case serving as an enclosure of the switch device.

Fig. 6 is a plan view of the switch device when conductive plates and drivers are disposed in the case.

Fig. 7 is a plan view of the switch device shown in Fig. 6 when a leaf spring is further mounted in the case.

Fig. 8 is a sectional view of the switch device shown in Fig. 7.

Fig. 9 is a sectional view of a conventional switch device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments according to the present invention will be described with reference to the drawings. Fig. 1 is an exploded perspective view of a switch device according to an embodiment of the present invention. Fig. 2 is a perspective view of the switch device when an operating knob is not mounted thereon. Fig. 3 is a sectional view of the switch device shown in Fig. 2. Fig. 4 is a diagram illustrating the operation of the switch device. Fig. 5 is a plan view of a case serving as an enclosure of the switch device. Fig. 6 is a plan view of the switch device when conductive plates and drivers are disposed in the case. Fig. 7 is a plan view of the switch device shown in Fig. 6 when a leaf spring is further mounted in the case. Fig. 8 is a sectional view of the switch device shown in Fig. 7.

The switch device shown in the drawings is a double-pole double-throw switch having two switch elements and is used as a driving switch in an automatic window unit in a vehicle.

The switch device mainly includes a case 10 having sidewalls 10b and 10c and dividers 10d orthogonal to a bottom wall 10a to form a pair of spaces S1 and S2 for housing contacts; a first group of contacts consisting of stationary contacts 11a, 11b, and 11c and a second group of contacts

consisting of stationary contacts 12a, 12b, and 12c, both groups of contacts being insert-molded on the bottom wall 10a of the case 10; three terminals 13 which extend from the stationary contacts 11a, 11b, and 11c and protrude downward from the case 10; three terminals 14 which extend from the stationary contacts 12a, 12b, and 12c and protrude downward from the case 10; a pair of conductive plates 15 and 16 tiltably disposed on the bottom wall 10a in the spaces S1 and S2, respectively; a pair of drivers 17 and 18 disposed on the plates 15 and 16, respectively, the drivers 17 and 18 being rotatable around shafts 17a and 18a thereof and movable vertically; a leaf spring 19 having a pair of pressing strips 19a and 19b which resiliently urge the shafts 17a and 18a toward the bottom wall 10a; a metal plate cover 20 attached to the case 10 to cover a top opening 10e of the case 10; and an operating knob 21 supported by a knob fulcrum 21a around which the knob 21 can move in a tilting motion. Referring to Fig. 4, the operating knob 21 includes downward pressing projections 21b and 21c that are in resilient contact with respective protruding receivers 17b and 18b of the drivers 17 and 18. The switch device is mounted on a circuit board 22 that includes a pair of push switches 23 and 24 near the case 10. The push switches 23 and 24 have upper pads 23a and 24a, respectively, disposed below the protruding receivers 17b and 18b.

The case 10 includes the two parallel longitudinal sidewalls 10c, the four dividers 10d, and the two lateral sidewalls 10b perpendicular to the sidewalls 10c. Each of

the sidewalls 10b and 10c and the dividers 10c is orthogonal to the bottom wall 10a. Referring to Figs. 1 and 5, the two sidewalls 10c have notches 10f on the upper edges (near the top opening 10e), and two of the dividers 10d have notches 10g on the upper edges. Both axial ends of the drivers 17 and 18 are disposed in the notches 10f and 10g and can be moved vertically therein. In other words, the axial ends of the driver 17 are disposed in the notches 10f and 10g in the left half of the drawing in Fig. 5, whereas the axial ends of the driver 18 are disposed in the notches 10f and 10g in the right half. The two lateral sidewalls 10b each have an opening extending from the top edge through the center to form a slit 10h. These slits 10h hold arms 17c and 18c of the drivers 17 and 18 and allow the arms 17a and 18a to move vertically. Furthermore, the sidewalls 10c are provided with projections 10i on the inner surfaces, and the dividers 10d are also provided with projections 10i on the surfaces facing the sidewalls 10c. The upper corners of these projections 10i are rounded so that the conductive plates 15 and 16 can be smoothly positioned during assembly.

The stationary contacts 11a to 11c, which are aligned on the bottom surface of the space S1, include a first stationary contact 11a in permanent contact with the conductive plate 15 and serving as a fulcrum, a second stationary contact 11b, and a third stationary contact 11c, both contacts 11b and 11c capable of being in contact with or out of contact with the conductive plate 15. Similarly, the stationary contacts 12a to 12c, which are aligned on the

bottom surface of the space S2 of the case 10, include a first stationary contact 12a in permanent contact with the conductive plate 16 serving as a fulcrum, a second stationary contact 12b, and a third stationary contact 12c, both contacts 12b and 12c capable of being in contact with or out of contact with the conductive plate 16. It should be noted that the first group of contacts 11a to 11c and the second group of contacts 12a to 12c are disposed point-symmetrically to each other in plan view. The three terminals 13 extending from the stationary contacts 11a to 11c and the three terminals 14 extending from the stationary contacts 12a to 12c are all connected to an external circuit.

Referring to Figs. 1 and 3, the conductive plate 15 is a metal plate and includes an initial holding portion 15a that supports the driver 17 when the operating knob 21 is not mounted; an elevated portion 15b having a reversed V-shape from a side view, and serving as a slope extending from one end of the holding portion 15a; a flat portion 15c extending from the other end of the holding portion 15a; and a movable contact 15d extending from the elevated portion 15b away from the holding portion 15a. The movable contact 15d moves into and out of contact with the stationary contact 11b, and the flat portion 15c has the same movement with the stationary contact 11c. Furthermore, the conductive plate 15 has four lugs 15e, two of the lugs being provided on one edge of the holding portion 15a and the other two lugs being provided on the other edge. The lugs 15e are engaged with the corresponding projections 10i of the case 10 to prevent

longitudinal dislocation of the conductive plate 15 during the tilting motion. The conductive plate 16, which has the same shape as that of the conductive plate 15, includes an initial holding portion 16a; an elevated portion 16b on one end of the holding portion 16a; a flat portion 16c on the other end of the holding portion 16a; and a movable contact 16d extending in one longitudinal direction. The movable contact 16d moves into and out of contact with the stationary contact 16d, and the flat portion 16c extending in the other longitudinal direction has the same movement with the stationary contact 12c. The conductive plate 16 has four lugs 16e, two of the lugs being provided on one edge of the holding portion 16a and the other two lugs being provided on the other edge. The lugs 16e are engaged with the corresponding projections 10i of the case 10 to prevent longitudinal dislocation of the conductive plate 16 during the tilting motion. Referring to Fig. 6, the conductive plates 15 and 16 are disposed point-symmetrically with each other in the case 10 in a plan view.

The driver 17 includes a sliding portion 17d which extends downward from the shaft 17a to sit on the conductive plate 15; the arm 17c which laterally extends adjacent to the shaft 17a to be disposed in a first slit 10h; the protruding receiver 17b provided on the end of the arm 17c to protrude from the sidewalls 10b; and a pair of guides 17e protruding from the shaft 17a to face each other over a predetermined distance. Similarly, the driver 18 includes a sliding portion 18d which extends downward from the shaft 18a to sit

on the conductive plate 16; the arm 18c which extends laterally adjacent to the shaft 18a to be disposed in the second slit 10h; the protruding receiver 18b provided on the end of the arm 18c to protrude from the sidewalls 10b; and a pair of guides 18e protruding from the shaft 18a to face each other over a predetermined distance. Referring to Fig. 6, the drivers 17 and 18 are disposed point-symmetrically to each other in the case 10 in plan view, thereby aligning the two arms 17c and 18c in a straight line. In other words, the drivers 17 and 18 are arranged in the case 10 in a state such that the arms 17c and 18c are disposed in a narrow space between the spaces S1 and S2 of the case 10, and that the protruding receivers 17b and 18b protrude through the pair of slits 10h which face each other in the longitudinal direction of the narrow space. Furthermore, the axial ends of the driver 17 are engaged with one pair of notches 10f and 10g, while the axial ends of the driver 18 are engaged with the other pair of notches 10f and 10g so that the drivers 17 and 18 can easily be disposed in the predetermined positions on the corresponding conductive plates 15 and 16.

The leaf spring 19 is formed by press-working a single metal spring plate into the shape shown in Fig. 1. The leaf spring 19 has a pair of parallel pressing strips 19a and 19b which are connected to the compressed portion 19c to form a substantial trapezoidal shape from a side view. The pair of pressing strips 19a and 19b resiliently urges the shafts 17a and 18a towards the bottom wall 10a. The cover 20 compresses the compressed portion 19c to create a spring force in the

pressing strips 19a and 19b. The compressed portion 19c includes a first bent strip 19d having sharply bent first longitudinal end segments extending from the pressing strips 19a and 19b, and a bridge 19e that bridges the end segments to form a substantially H-shape; and a second bent strip 19f having sharply bent second longitudinal end segments extending from the pressing strips 19a and 19b, and a bridge 19g that bridges the end segments to form a substantially H-shape. Referring to Figs. 7 and 8, the leaf spring 19 is disposed at the top of the case 10 during assembly so that one pressing strip 19a is disposed on the shaft 17a of the driver 17 and the other pressing strip 19b is disposed on the shaft 18a of the driver 18. During assembly, the pressing strip 19a is fitted between the two guides 17e and the pressing strip 19b is fitted between the two guides 18e to position the leaf spring 19 laterally. Furthermore, the longitudinal length of the leaf spring 19 may be set substantially equal to the length between the two sidewalls 10b so that the pressing strips 19a and 19b of the leaf spring 19 can be positioned longitudinally. Thus, the leaf spring 19 can be easily and securely assembled into the predetermined position in the case 10.

The cover 20 is provided with mounting tabs 20a at the lower four corners, and is attached to the case 10 by bending the tabs 20a into engagement with the four corners of the case 10 to cover the top opening 10e. Thus, the cover 20 attached to the case 10 causes the pre-mounted leaf spring 19 in the case 10 to be resiliently deformed from the state in

Fig. 8 to the state in Fig. 3. In detail, when the cover 20 is mounted above the leaf spring 19 disposed at the top of the case 10, the cover 20 resiliently urges the first bent strip 19d and the second bent strip 19f. Thus, the resilient force is applied towards the pressing strips 19a and 19b to create a spring force therein. The spring force causes one pressing strip 19a to resiliently urge the shaft 17a towards the bottom wall 10a, thereby causing the sliding portion 17d to resiliently contact the conductive plate 15. Rotating the driver 17 around the shaft 17a, therefore, causes the sliding portion 17d to slide on the conductive plate 15, also causing the conductive plate 15 to tilt. Similarly, the same spring force causes the other pressing strip 19b to resiliently urge the shaft 18a towards the bottom wall 10a, thereby causing the sliding portion 18d to resiliently contact the conductive plate 16. Rotating the driver 18 around the shaft 18a, therefore, causes the sliding portion 18d to slide on the conductive plate 16, also causing the conductive plate 16 to tilt.

The switch device described above includes a first switching element having the space S1 for housing components such as the stationary contacts 11a to 11c, the conductive plate 15, the driver 17, and the pressing strip 19a; and a second switching element having the space S2 for housing components such as the stationary contacts 12a to 12c, the conductive plate 16, the driver 18, and the pressing strip 19b. The first and second switching elements are arranged in parallel in the case 10 and receives the restoring force of

one common leaf spring 19.

When the switch device is installed in an automatic window unit in a vehicle, the operating knob 21 (with reference to Fig. 4) is mounted on the top of the case 10. In this mounting process, the pair of pressing projections 21b and 21c of the operating knob 21 are brought into resilient contact with the respective protruding receivers 17b and 18b to create a pretension which eliminates the backlash between the operating knob 21 and the drivers 17 and 18. In such a pretension state, the sliding portions 17d and 18d are positioned near the bottom of the slopes of the respective elevated portions 15b and 16b. When the operating knob 21 is removed, as is shown in Fig. 3, the sliding portions 17d and 18d, respectively, come into contact with the initial holding portions 15a and 16a to slightly raise the protruding receivers 17b and 18b. The movement of the drivers 17 and 18 from the state in Fig. 3 to the pre-tension state may be estimated to determine the initial positions of the drivers 17 and 18 and the shapes of the conductive plates 15 and 16. This estimation facilitates a structure that allows the protruding receivers 17b and 18b to have a large vertical motion when the sliding portions 17d and 18d slide on the conductive plates 15 and 16.

The operation of the switch device including the above components will now be described. In the stand-by mode free of an operating force (the pre-tension state described previously), the sliding portion 17d of the driver 17 is in resilient contact with the bottom slope of the elevated

portion 15b of the conductive plate 15. Hence, the stationary contacts 11a and 11c are electrically connected via the conductive plate 15, whereas the stationary contacts 11a and 11b remain in an OFF mode. In the same manner, the sliding portion 18d of the driver 18 is in resilient contact with the bottom slope of the elevated portion 16b of the conductive plate 16. Hence, the stationary contacts 12a and 12c are electrically connected via the conductive plate 16, whereas the stationary contacts 12a and 12b remain in an OFF mode.

When force is applied to the operating knob 21, as is shown with the arrow in Fig. 4, the pressing projection 21b presses the protruding receiver 17b of the driver 17. As the receiver 17b is pressed, the arm 17c moves counterclockwise in the drawing. The sliding portion 17d then slides upward along the slope of the elevated portion 15b of the conductive plate 15. Finally, the shaft 17a is slightly raised against the pressing strip 19a. The sliding portion 17d then passes over the stationary contact 11a and tilts the conductive plate 15, resulting in the state shown in Fig. 4. As a result, the flat portion 15c moves out of contact with the stationary contact 11c while the movable contact 15d contacts the stationary contact 11b. The stationary contacts 11a and 11b are thus electrically connected, whereby a switch ON signal (a driving signal for opening a window) is output from the terminals 13.

When the operating force is removed from the operating knob 21 in the state shown in Fig. 4, the restoring force of

the pressing strip 19a is applied to the shaft 17a of the driver 17, and thereby sliding the sliding portion 17d downward along the slope of the elevated portion 15b. When the sliding portion 17d reversely passes over the stationary contact 11a, the conductive plate 15 is tilted in reverse, that is, counterclockwise in the drawing, and the pressing projection 21b is pressed upward by the protruding receiver 17b. As a result, the movable contact 15d moves out of contact with the stationary contact 11b while the flat portion 15c moves into contact with the stationary contact 11c. The stationary contacts 11a and 11b are thus disconnected, whereby a switch OFF signal is output from the terminals 13 and the stand-by mode in which the operating knob 21 is substantially horizontal is recovered.

Another feature of the operation of this apparatus will be described. When the operating knob 21 is further pressed in the state of Fig. 4, the sliding portion 17d slides further along the elevated portion 15b, whereby the shaft 17a receives a greater resilient force from the pressing strip 19a. With the protruding receiver 17b being further pressed downward by the pressing projection 21b, the receiver 17b pushes the upper pad 23a to turn on the push switch 23. The push switch 23 then outputs a driving signal for fully opening the window. When the operating force is removed from the operating knob 21 in this state, the force of the pressing strip 19a causes the sliding portion 17d to slide downward along the slope of the elevated portion 15b, thereby changing back to the state in Fig. 4 and then to the stand-by

mode.

When the operating knob 21 is tilted in the stand-by mode so as to push the pressing projection 21c against the protruding receiver 18b of the driver 18, the arm 18c moves and the sliding portion 18d slides upward along the slope of the elevated portion 16b. This causes the shaft 18a to be pressed against the pressing strip 19b and allows the sliding portion 18d to pass over the stationary contact 12a to tilt the conductive plate 16. The stationary contacts 12a and 12b are thus electrically connected, and a switch ON signal (a driving signal for closing the window) is output from the terminals 14. When the operating knob 21 is further pressed, the pressing projection 21c pushes the upper pad 24a via the protruding receiver 18b, thereby allowing the push switch 24 to be turned on to output a driving signal for fully closing the window. When the operating force is removed, the resilient force of the pressing strip 19b causes the sliding portion 18d to slide downward along the slope of the elevated portion 16b. As a result, the conductive plate 16 is tilted in reverse while the protruding receiver 18b pushes the pressing projection 21c upward to be changed back to the stand-by mode.

As described above, the switch device of this embodiment allows the operating knob 21 to directly press against the drivers 17 and 18 and therefore does not require other intermediate driving elements. Furthermore, the leaf spring 19 disposed in the narrow space on the shafts 17a and 18a can provide an apparatus with a lower profile. In this apparatus,

the push switches 23 and 24 is turned on when the protruding receivers 17b and 18b are pressed with the operating knob 21, enabling an operation without an external driving element for the push switches. Furthermore, this multifunctional apparatus performs manual operation as well as full-opening and full-closing operations and accomplishes compactness and low profile without having a complex structure.

In the assembly of this switch device, the conductive plates 15 and 16 and the drivers 17 and 18 composing the two switch elements are mounted on the bottom wall 10a of the case 10, and the leaf spring 19 and the cover 20 are then mounted on the switch elements. This assembly process is efficient. Furthermore, during the mounting of the cover 20, the compressed portion 19c of the leaf spring 19 is urged by the cover 20, creating spring forces in the pressing strips 19a and 19b. Consequently, both of the switch elements receive the restoring force of one common leaf spring 19. The positioning of the conductive plates 15 and 16 with the projections 10i in the case 10, the positioning of the drivers 17 and 18 with the notches 10f and 10g and with the slits 10h, and the positioning of the leaf spring 19 with the sidewalls 10b and with the guides 17e and 18e in the drivers 17 and 18 during the assembly enables automatic assembly of the apparatus without misalignment of components. Thus, the assembly costs can be greatly reduced. Since the top opening 10e of the case 10 is covered with the cover 20, the switch device is protected from the entry of foreign dust particles into the case 10, preventing poor connection and short

circuiting to achieve a high reliability of the apparatus for a longer period of time.

In the switch device of this embodiment, the two switch elements are arranged point-symmetrically in plan view. Specifically, all the stationary contacts 11a to 11c and the stationary contacts 12a to 12c, the conductive plate 15 and conductive plate 16, and the driver 17 and the driver 18 are arranged point-symmetrically. This contributes to the compactness of the apparatus for effectively using the spaces provided in the case 10. Furthermore, the sidewalls 10c and the dividers 10d are provided with the notches 10f and 10g in which the axial ends of the drivers 17 and 18 are fitted and can move vertically, and the sidewalls 10b have slits 10h in which the arms 17c and 18c are fitted and can move vertically, thereby maintaining the space for moving the drivers 17 and 18 while minimizing the height of the case 10.

The switch device of this embodiment has a structure in which the driver 17 is disposed between the conductive plate 15 and the pressing strips 19a, and the driver 18 is disposed between the conductive plate 16 and the pressing strip 19b. This structure allows the sliding portions 17d and 18d, respectively, to resiliently contact the conductive plates 15 and 16, and also allows the protruding receivers 17b and 18b, respectively, to resiliently contact the pressing projections 21b and 21c. Accordingly, the leaf spring 19 resiliently urges the shafts 17a and 18a towards the conductive plates 15 and 16. When force is not applied on the operating knob 21, a resilient force tries to move the sliding portions 17d and

18d downward along the slope of the elevated portions 15b and 16b, causing the protruding receivers 17b and 18b to resiliently bias upward against the pressing projections 21b and 21c of the operating knob 21. On the other hand, when force is applied on the operating knob 21, the pressing projection 21b (or 21c) directly presses the protruding receiver 17b (or 18b) to move the sliding portion 17d (or 18d) on the conductive plate 15 (or 16), whereas the removal of the force on the operating knob 21 causes the protruding receiver 17b (or 18b) to press against the operating knob 21. In this manner, the backlashes between the operating knob 21 and the drivers 17 and 18 are prevented during operation, thereby always achieving a good manipulation of the apparatus.